DR. LARRY E. CHASE
DAIRY SCIENTIST & CONSUMMATE EXTENSION EDUCATOR: HIS PROFOUND AND POSITIVE IMPACT ON THE DAIRY INDUSTRY

W. S. Burhans
Dairy-Tech Group
S. Albany, VT

INTRODUCTION

Few scientists have had as great an impact on the dairy industry as our own Dr. Larry Chase. His influence on the dairy industry extends from the local New York and regional Northeastern industry to the national and international dairy industry. He has made this mark by operating in his own inimitable way: thoughtful, passionate, unassuming, and persistent. He is not only a fantastic teacher, a critical thinker, and an astute scientist, but a wonderful man. He has been tremendously effective at guiding and educating those of us in the dairy industry, including producers, agriservice personnel and other dairy scientists. He has accomplished this without being “flashy” or “high profile”. Because he is modest and typically operates in a low-key fashion, his contribution might be underestimated by those who are less familiar with his extensive work.

The intent of this paper is to pay tribute to Dr. Chase by recognizing his efforts, accomplishments and impacts on the dairy industry. To accomplish this objective it is useful to consider the body of written work Dr. Chase has produced over his career. This written work reflects his interests and priorities as he decided what would serve us best. Also, in his spirit of ever being the teacher, we will reflect on Dr. Chase’s career and on the man, in hopes of drawing attention to contextual factors that are important to understanding him and to his career and his successes, considerations that we would do well to be mindful of as we move forward in the dairy industry. We will also note the importance to his successful impact on the dairy industry of the Cornell University Animal Science Department, and the colleagues with whom he has worked.

To understand just how big an impact Dr. Chase has had, we must appreciate not only his efforts and results, but, importantly, the context of his contribution. Understanding that context requires recalling what the industry was like forty years ago, when his career at Cornell started. For those that understand the nature of the industry then and how it contrasts with the industry now, perhaps most striking are major differences in dairy herd productivity, and in technology used in the industry. There are also huge differences in our understanding of basic bovine biology, especially of dairy nutrition. We have been most fortunate that Dr. Chase was there to guide us as these aspects of the industry changed and new ones emerged and were applied in the field to dairying, especially dairy nutrition.

Not surprisingly, there have been tremendous gains in productivity during the period encompassed by Dr. Chase's career (Figure 1). To understand the choices and priorities he focused on as an Extension educator, one must appreciate what it was like in 1975 to be working with herds that averaged somewhere around 35 lbs. milk/cow/day. There is no doubt that his efforts in educating and informing the dairy industry stakeholders contributed tremendously to the increase in the current herd average to about 72 lbs. milk/cow/day, double the performance of herds when Dr. Chase began his career. In an alternate world where he had chosen a different career, surely we would have seen flatter growth in productivity.

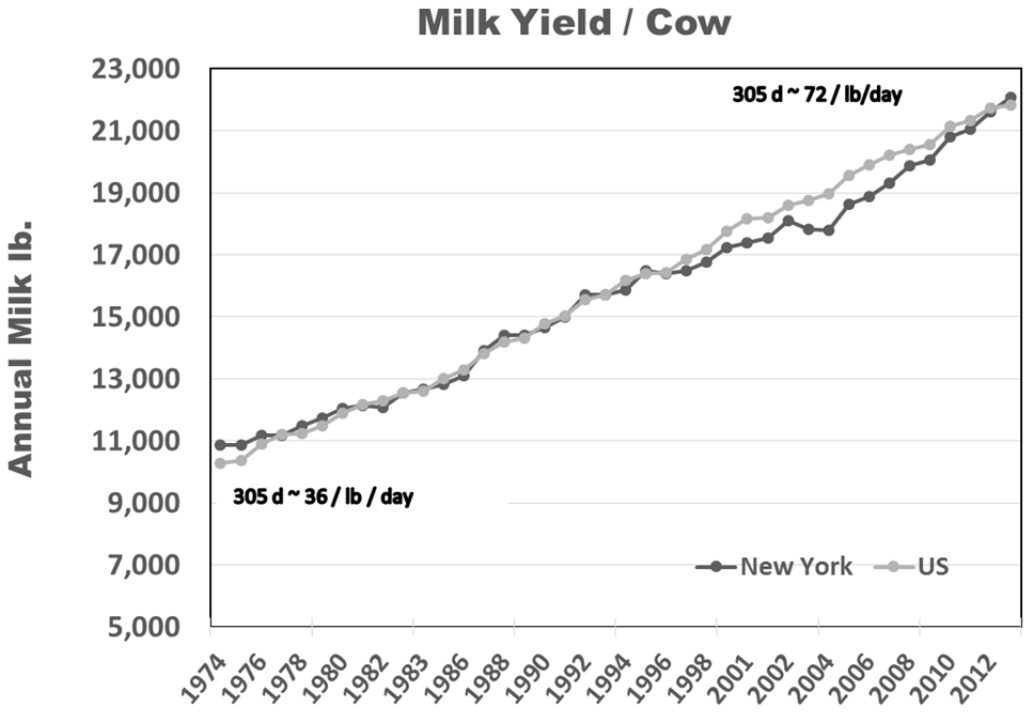

Figure 1. Annual Production per Cow for New York State and US Dairy Herd. (NASS, USDA 2013)

In addition to changes in productivity over the course of Dr. Chase's career, to fully appreciate his contribution one must also appreciate the changes in scientific understanding of dairy nutrition and biology during this time and the far less sophisticated technology that was employed circa 1975 compared to now. Thinking of technology, we might be tempted to consider some of the amazing and sophisticated technologies developed in recent years, such as robotic milkers, protected amino acids, rBST, or the Cornell Net Carbohydrate and Protein System (CNCPS). But the differences between technology now and in 1975 are far more striking and fundamental than these examples might suggest. Indeed, most of the differences in applied technology and management or biological concepts are far more ordinary and elementary and are often taken for granted today. For instance, in 1975 few dairymen used Total Mixed Rations, which are in use ubiquitously today. In 1975, we mostly fed

the same standard line feeds, not custom mixes. We fed mostly dry hay, and far less ensiled feeds. The ensiling process, optimal moisture content of ensiled feeds and forage quality were neither understood nor appreciated as well as they are today. Evaluating our results was far more difficult because electronic records transfer from DHIA such as the RMS system, was not available, nor were on-farm herd records systems used much. DHI records and hand-written cards or paper were the major herd-level information sources. DHI reports were mainly canned, and were not very diagnostic compared with current herd analytic tools.

We balanced rations with paper and pencil, not a computer. We balanced rations for crude protein and TDN in 1975, and not for the multiple protein fractions, such as soluble or degradable protein, much less protein fraction A1 (soluble NPN, i.e. ammonia), A2 (soluble true protein), B1 (true protein, medium degradation rate), B2 (true protein, slowly degraded), and ADIP C (indigestible). We balanced for crude protein. Period! Can you imagine trying to have a conversation with a 1975 feed man or dairy farmer about the need to adjust soluble protein level, or the level of bypass methionine, or the amount of fermentable starch? Or perhaps recommending that he should increase the amount of B2 protein in the diet of his cows (remember, we did not yet know about “bypass protein”)? Today, dairymen and their feed advisors frequently have these conversations, and many others like them, because Dr. Chase superbly executed his mission of informing us about these new scientific concepts as they emerged. His effort didn’t stop with informing us - he also untiringly trained us in the application of these new concepts and tools in the field.

So, truly appreciating the impact Dr. Chase has made on the industry requires us to mentally travel back in time to the era when he began his efforts to make us better at what we do. Once we have recalled these efforts, we need to reflect on just how radically different our day-to-day jobs have become, especially in dairy nutrition, as a result of Dr. Chase’s efforts. These differences are substantial thanks to his efforts to help us understand and implement modern dairy nutrition. The magnitude and scope of Dr. Chase’s educational and training efforts can be illuminated by examining the plethora of writings he produced over his career, as they reflect the topics and issues that he addressed with us.

THE WRITTEN LEGACY

Understanding Dr. Chase’s contribution to the dairy industry requires an appreciation of the two most important roles he has played in this industry during his career. Not only is he an excellent dairy scientist, he is also the epitome of a knowledgeable and effective extension educator. In both roles Dr. Chase became a prolific author - he has authored or coauthored over 1000 publications on dairying and dairy nutrition, including journal articles (70), extension publications (589), proceedings and abstracts (260) popular press articles (99), and book chapters (13). Reviewing the topics addressed in this large body of work sheds additional light on his many contributions as a scientist and as an educator.

Extension and Popular Press Articles

The collected titles of the approximately 690 extension articles and popular press articles Dr. Chase has authored or co-authored during his career presumably reflect contemporary issues, innovations, and concerns at the time they were written. They cover a broad range of topics, and their titles provide a perspective on the issues Dr. Chase identified as important topics for educating the rest of us in the industry. To get a sense of the relative importance of a topic to our industry proportionate to his efforts as educator I broadly categorized the extension and popular press articles by topic (based on titles) and then aggregated the topics by the number of times each one was a major focus of an article, and then calculated the proportion of the total times ("Relative Frequency") these topics were addressed in the 690 extension articles and popular press articles Dr. Chase authored (Figure 1). I assumed that a topic reflected a locus of Dr. Chase's attention at the time it was written. This categorization was not rigorous, and some articles were allowed to reflect two central foci and some might just as appropriately have been categorized differently. Nonetheless, this analysis should illuminate some of Dr. Chase's interests and the issues he addressed during his career. A world of specific issues and interests remains invisible when Dr. Chase's contributions are reduced to a list of topics, but this exercise coarsely reveals a sense of the questions important to the industry that he addressed during his career. Some specific subtopics within each category would be outdated today because progress in scientific understanding and technology have rendered them obsolete. Some only appear early or later in his career, and some appear repeatedly, reflecting perhaps an important issue that remains less than completely established in practice or one that recurs because of the evolution of our understanding of the underlying biology or of pragmatic application.

Within these categorizations the titles reveal specific subjects that he identified as sufficiently important to the industry to educate others about. For instance, this analysis reveals that forage is the most frequently addressed topic. In fact, the first five articles Dr. Chase published in the popular press following his appointment at Cornell were all about forage, tackling issues such as forage quality, forage testing, forage dry matter, and hay preservatives. Chief among the factors that contribute to successfully and profitably feeding dairy cows is forage quality. This analysis reveals that right out of the gate, educating others on this topic was an early focus of Dr. Chase's efforts as an educator. Indeed, in the first two years of his career at Cornell Dr. Chase penned 12 extension articles and 7 popular press articles about forage. Interestingly, in the years 2013-2014, forage continued to be a major topic addressed in Dr. Chase's publications, undoubtedly because it remains a (*the?*) primary determinant of nutritional performance in dairy cows. However, the specific forage subtopics in 9 extension articles and 5 popular press articles in these most recent years are different from the subtopics addressed earlier and reflect differences in our understanding of biology and feed chemistry or differences in technology. Instead of stressing forage quality as heavily (which was certainly a priority need in 1975), his recent forage articles address subjects such as nitrates in droughty corn silage, feeding immature corn silage, feeding higher forage rations, small grain silages, using corn silage processing scores, and shredlage.

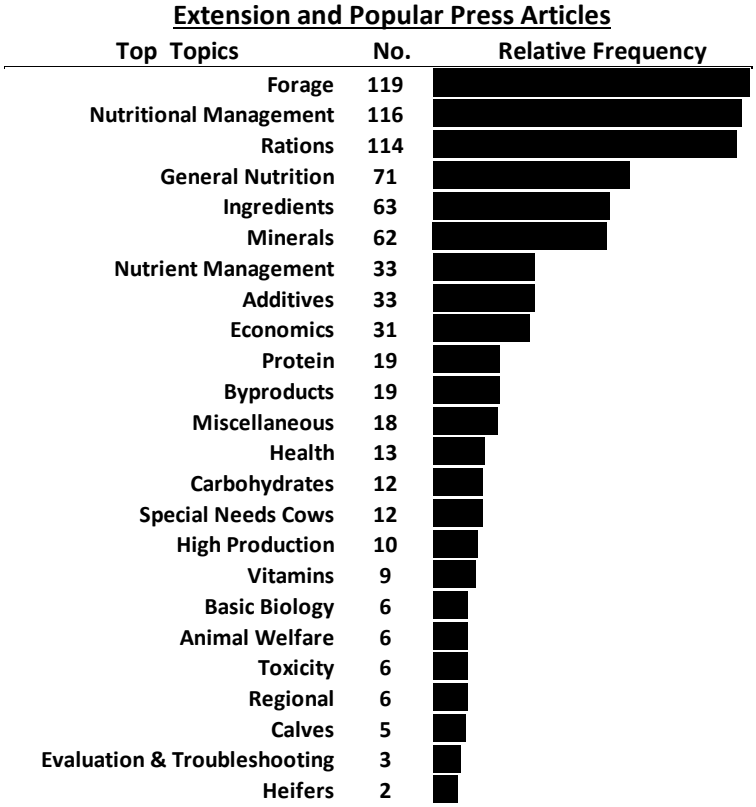

Figure 2. Broad categorization and distribution by subject of major topics addressed in Extension and popular press articles authored or coauthored by Dr. Larry Chase.

Dr. Chase's published ruminations in these most recent forage related topics are quite different from topics he addressed earlier in his career and suggest several factors that have contributed to his exceptional impact on our industry. First, in his efforts Dr. Chase has always been sensitive to contemporary problems facing dairy farmers, and made it a priority to be responsive in a timely way to contemporary issues or crises affecting dairy producers. In years where there has been drought or other weather-related factors that negatively affect crop maturity, or severe economic pressure from low milk prices, for example, Dr. Chase supplied timely guidance and direction. Thus the recent publications on droughty or immature silages.

Second, Dr. Chase has been effective in moving the industry toward more productive practices. This is exemplified in the more recent articles by his lack of need to focus as much primarily on forage quality per se. Dr. Chase has been there. Taught us that. He might have to remind us in the future, but he got the message across in the past. We are at a different place with regard to our appreciation of the importance of forage quality than we were in 1975, and we got there with a lot of help and guidance from Dr. Chase. He did, after all, publish 119 articles on forage!

Thirdly, several of Dr. Chase's most recent articles highlight his ongoing focus on emerging technology, notably in these recent articles on kernel processing scores and shredlage. Weren't no processors or shredlage units in 1975! Dr. Chase's publications have always been focused on helping us understand, evaluate, and apply new technologies. Time and space preclude delineating all the new technologies he has guided us on, but it is safe to say that every one of the new feeding and nutrition technologies brought to the industry in the last 40 years were addressed in publications by Dr. Chase. rBSt. Ionophores for heifers. Ionophores for lactating cows. TMR feeding. Formulating rations with TI-59 programmable calculators. New forage testing assays. CNCPS. Wide swathing of forages. BMR corn silage. Magnetic grain feeders. New ration formulation softwares. Rumen protected fat. Rumen protected amino acids. Heat treated feeds. The Penn State shaker box. RFV. RFQ. Isoacids. This is a very incomplete list of the emerging technologies that Dr. Chase helped us to implement. In reflecting on Dr. Chase's career, we would do well to remember two things relative to emergent dairy nutrition science and technology. First, most of these technologies were either nonexistent or extremely primitive and rarely employed in 1975. Most of them were eventually widely adopted by producers and agriservice providers. Dr. Chase had an important role in their assessment and adoption through his extension educational efforts. Second, new technology, and Dr. Chase's guidance in the evaluation and appropriate utilization of these emergent technologies, has certainly been a major factor in the productivity gains described earlier in this document.

Conference Proceedings, Summaries and Abstracts

Dr. Chase's appointment at Cornell involved a mix of extension (70%) and research (30%) responsibilities. Dr. Chase's writing legacy includes 260 publications in the form of proceedings or abstracts. Titles in this group demonstrate his integration of the Research and Extension aspects of his appointment at Cornell. Reviewing them, one is struck by several things. First, Dr. Chase has been directly involved in a remarkably large amount of research at multiple levels of nutrition, biology, and dairy nutritional management. On the one hand, he's performed a large amount of basic biology and nutrition research. This work has been diverse, and examples of his basic research include chloride requirements of dairy cows, understanding liquid and particulate passage rates in dairy heifers, cation exchange capacity of feedstuffs, and in vitro digestion kinetics, for example. The proceedings and abstracts Dr. Chase has published also demonstrate his involvement in an extraordinarily large amount of applied dairy nutrition research. His work in this area also encompasses a broad array of applied nutrition, examples including research on isoacids, several studies on buffers, trials examining the influence of NDF on early lactation performance, and studies on phosphorus and protein nutrition. His interest in being a student of the cows, so to speak, and of us as well, is revealed in many of his proceedings articles and abstracts that address such diverse areas as descriptions of diets fed to very high producing herds, surveys of nutritionists' practices for forage carbohydrate analysis, troubleshooting nutrition problems, and strategies for feeding for 30,000 pounds of milk. As most of us know, Dr. Chase has had a longstanding interest in feeding byproducts; this is apparent in publications beginning early in his career, when he first examined

byproduct feeds such as wet brewers grains in 1977, byproducts in general in the early 1980s, distillers grains in 1983, and then fibrous byproducts (such as soy hulls) in 1995. In addition to Dr. Chase's efforts to improve the nutrition we provide our cows Dr. Chase also began promoting the tools we need to do this well. He has studied and written about "meta-nutrition", the tools and practices that enhance the delivery and management of good nutrition. His publications include a number of studies that assessed several enzyme additives, new ration formulation software, body condition scoring (including the use of ultrasound for body condition scoring), and certification of nutrition professionals. These are just a small sample of the numerous subjects he has communicated in proceedings publications or in published abstracts. The range and extent of the topics he has researched and taught is stunning. It is difficult to imagine a successor capable of providing equally broad and extensive expertise as a dairy extension educator, or who will be able to provide a similar breadth of knowledge to the industry.

Journal Articles

Dr. Chase's extraordinary efforts on behalf of the dairy industry and the diversity of his interests are evident when one reviews the titles of the 70 peer reviewed journal articles he has authored or co-authored. Using the same approach employed to summarize his extension and popular press publications in Figure 2, I broadly categorized by topical area his research published in peer-reviewed journals, and then aggregated research topics by relative frequency. Figure 3 then summarizes the topics of his journal publications and the frequency with which Dr. Chase addressed them.

The distribution of topics revealed by this analysis indicates that forage and feed ingredients have also been a major focus of Dr. Chase's research as well as his extension publications. During his later career collaborations at Cornell with Drs. D.J. and J.H. Cherney on forages have been especially helpful to Northeast dairy producers who require high quality forages in regions where growing alfalfa is difficult. The chronology of the titles of his Journal articles also suggests partial changes Dr. Chase's research interests over time. For instance, early in his career as an animal scientist he published studies of metabolism and physiology and on chloride requirements of dairy cows. His early career mineral studies also investigated buffers and selenium. A review of Dr. Chase's journal publications in this area reveals just how far the industry has advanced since 1975; especially notable is how little understanding we had of basic nutrient requirements such as how much salt cows need. It's likely that every field nutritionist at this conference makes a deliberate and considered inclusion of salt and buffer in the diet for lactating cows every day. It is hard to fathom how this might have been accomplished in 1975 when we simply did not know the optimum amount of either buffer or salt to include in diets. Dr. Chase's research contributed to something as basic as that. This is a pointed example of how dairy feeding is so much better informed today than it was in 1975, especially as related to nutritional factors that contribute to higher productivity.

In the latter portion of his career, Dr. Chase's research included many wonderful collaborations and addressed critically important industry and societal concerns pertaining to environmental issues and nutrient management. In this regard, the broader topic of nutrient management is relevant to and parallels the development and utilization of the Cornell Net Carbohydrate and Protein System model. Dr. Chase clearly is passionate about both, and addressed both the environment and the application and use of the CNCPS model in a number of research studies and Journal paperson phosphorus and protein nutrition. All of us, both dairy producers and feed advisors, are far better informed and effective in our jobs because of this component of Dr. Chase's research. And we also feed far less expensive nitrogen and phosphorus!

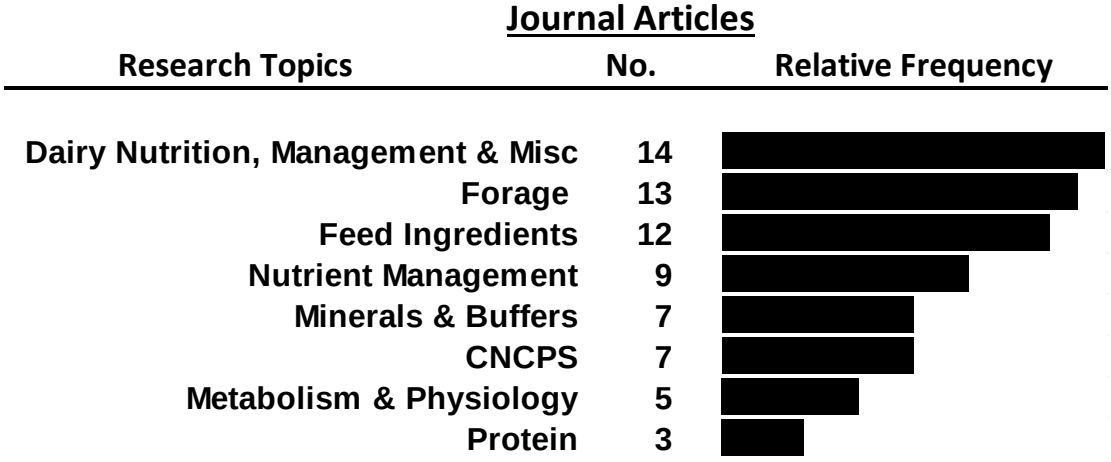

Figure 3. Broad categorization and distribution by subject of major topics of peer reviewed journal articles authored or coauthored by Dr. Larry Chase

OTHER EVIDENCE OF DAIRY INDUSTRY IMPACT

Beyond his body of written work, other evidence of the powerful impact Dr. Chase's career has had on our industry includes the recognition bestowed on him by the many national and regional awards he has received from industry and from his academic peers, awards which are too numerous to completely describe here. For instance, Dr. Chase was a recipient of the Distinguished Nutritionist Award in 1990 from the Distillers Feed Research Council, and of the Distinguished Service Award in 2009 from the Northeast Ag and Feed Alliance. Awards he has received from his academic colleagues include, for example, the DeLaval Dairy Extension Award received from the American Dairy Science Association in 2000, and the Extension Faculty Award received three years later in 2003 from by the New York State Association of County Agricultural Agents. Cornell University has recognized Dr. Chase and his important contributions to dairy science several times, such as the 2012 award for Outstanding Accomplishments in Extension Outreach awarded by the Cornell University College of Agriculture and Life Sciences. Dr. Chase also shared the Cornell College of Agriculture-Extension Outreach Team Award in 2007 with Drs. Dan Fox, Mike Van Amburgh, and Tom Overton for their work with the CNCPS model.

Dr. Chase's impact on the dairy industry is also reflected in the large number of graduate students he has trained. Dr. Chase has served as the major advisor for 19 students and served on the thesis committees of an additional 27 students who have completed their graduate degrees at Cornell. Not all of these students are personally known by this author – indeed, some completed their graduate work decades ago (the earliest finished training in 1979). However, the author knows enough of these students and is familiar enough with their research and careers to understand that Dr. Chase's training of graduate students has, and is, contributing to many facets of the dairy industry. Dr. Chase's former graduate students clearly demonstrate that his influence includes the training of many influential and successful industry professionals. His former graduate students also include research scientists in academia and government, individuals working in dairy extension, feed and allied industry technical scientists, and a number of people in feed or allied industry management positions. Several former students have established their own agribusinesses. Also, a large cohort of Dr. Chase's former graduate students have worked directly with dairy producers in a variety of positions as consultants and advisors.

Those who know Dr. Chase also understand that the impact of his career on dairy science and the dairy industry has involved his participation in a wide variety of dairy science and industry meetings. It is not possible to compile and review the number of educational meetings Dr. Chase has contributed to over his career - they are simply too numerous and a suitable database for doing so does not exist. Suffice it to say that over the course of his career there have been a multitude of educational meetings at which Dr. Chase pursued his ongoing mission to educate and train us in contemporary dairy nutrition. These meetings include a plethora of conferences, field days, training meetings, industry meetings and consulting sessions.

High on the list of meetings that have had a great impact on dairy science and the dairy industry is this conference, for which Dr. Chase is serving as Program Chair. This conference is arguably the premier dairy nutrition conference in the world, and Dr. Chase has been the program committee chair or the overall program chair for many years, beginning in 1985. Another high impact nutrition event that owes its existence to Dr. Chase is the annual four day nutrition short courses held by Cornell each year. Dr. Chase, along with Dr. Charles Sniffen, initiated these courses in the late 1980s. Alternating between basic nutrition courses and advanced courses, these courses are attended by participants from all over the world. They accomplish two important functions. First, they provide a great opportunity for experienced nutritionists to keep up to date with the most current nutritional biology and science in in-depth sessions on contemporary and emerging topics taught by leading scientists. Second, many feed manufacturers utilize these courses as an opportunity to provide valuable training to newer, younger hires. Similarly, the annual Feed Dealers meetings provide a shorter, more easily accessible venue (at 7 locations) where current issues for feed advisors are addressed. One successful feed company executive has said that these sessions are so valuable that he sends not just his company sales representatives, but also his mill

managers so that all members of his team understand the contemporary issues addressed at this annual series.

Dr. Chase's career has not just impacted feed industry personnel, but also another important cadre of influential farm advisors, dairy veterinarians. Since 1984, Dr. Chase and Dr. Mike Hutjens have taught a two-day course in dairy nutrition for veterinarians at the annual American Association of Bovine Practitioners meeting. This course typically is taught to approximately 30 veterinarians each year. More recently, he has collaborated with Dr. Tom Overton to teach a course at the Cornell College of Veterinary Medicine titled "Applied Dairy Nutrition for Practitioners". Given the strong links between nutrition and health, Dr. Chase's these efforts at reaching dairy veterinarians have been very important to dairy veterinary practitioners and to the dairy industry.

While the recurring meetings described above have involved major and repeated investments of Dr. Chase's time and effort during his career, the number is small compared to the many shorter meetings Dr. Chase contributes to and participates in each year. Just a limited description of Dr. Chase's recent participation in other meetings demonstrates his extensive commitment and contribution to industry progress. For example, Dr. Chase recently participated in meetings on pasture utilization (NE Forage Pasture Consortium), producer meetings on precision farming (Delaware County Feed Management meetings for Dairy Producers) and in a meeting that addressed the training of cooperative Extension Agents (Mid-Atlantic Consortium Dairy Extension Training Program). Recent invitations Dr. Chase has received to speak at meetings include many dairy conferences, both in the US and internationally. Recent international invitations have included a request to speak at the Western Canadian Dairy Seminar (Canada) and the Zenrakuran seminar series (Japan). Here in the states recent requests for Dr. Chase to speak have included the Progressive Dairy Operators Conference (Wisconsin), and the 4-State Dairy Nutrition Conference (Iowa). Always the teacher, Dr. Chase's participation in meetings has been an important aspect of his commitment to educate and inform us of new and better ways to implement dairy nutrition.

Finally, any attempt to describe Dr. Chase's impact on the dairy industry, must make note of the enormous appreciation and affection those who have directly experienced his efforts on behalf of the industry have for Dr. Chase. More than just being appreciated for his work, Dr. Chase is beloved by many with whom he has worked during the course of his career. His contributions as an educator and scientist cannot be measured just by his research and teaching; this equation must also include how frequently and well he interacted with us as farmers or as students in the classroom and laboratory, or with all of us at meetings. Comments made by the nutritionist John Zmich capture this well: "Larry created an atmosphere that my colleagues in the industry looked forward to…there was nothing self-promoting about Larry…he simply dispensed information for the greater good of agriculture. In his quiet effective way Larry helped bring about some real change." Dr. Chase is enormously appreciated by the dairy producers he has served, as noted by Willard De Golyer, a successful dairy producer

from Castile, NY, who has said “We can reach out to Larry when challenging…decisions must be made, and he always has a prompt, well thought-out answer.” Dr. Chase has been tremendously appreciated for his accessibility and delivery style as well. John Mitchell, a New York feed company executive, is effusive in his recognition that while Larry had brilliant colleagues, Larry’s delivery of material was unsurpassed, and commented that “He has an exceptional talent for making his subject clear and understandable.” John also remarks on how wonderful it was to meet with Larry on farms. Says John: “Larry exemplifies the essence of what the Land Grant system is supposed to be.” No one who is familiar with Dr. Chase’s research, teaching, and service to stakeholders in the dairy science world would disagree.

REFLECTIONS

We in the dairy industry are grateful for the enormous contributions that Dr. Chase has made to our industry throughout his career. He conducted this career with a passion for dairy science, for cows, and for the well-being of our industry. The review of his career and accomplishments occasioned by his retirement has brought to light the tremendous effort he has expended on our behalf, over many years and in many ways. While it was his passion, we recognize that it was also a prodigious amount of work. He has been prolific in his output, and tireless and unceasing in his endeavors on our behalf.

We are also mindful that Dr. Chase’s accomplishments on our behalf were made as a member of the Department of Animal Science at Cornell, which has a long history of ground-breaking, high-impact science made possible by support from the University and the community. Dr. Chase’s career has clearly made a huge impact on all of us as individuals, which is something he accomplished as a member of what is arguably the most influential academic department of animal science and animal nutrition in the world. The Cornell Department of Animal Science team has included, and continues to include, some of the greatest animal scientists in the world, now and in the past. Indeed, many practicing nutritionists in the world have in their background studying Morrison’s Feeds and Feeding text (it is still possible to enter Morrison Hall and sit at Morrison’s desk!) However, we should be very concerned for the current team of scientists and technicians in the Cornell Department of Animal Science, who, like Dr. Chase, have dedicated their careers to pursuing the goals pursued by Dr. Chase during his career. It will be difficult, perhaps impossible, for these scientists and technicians to continue their efforts to build upon the extraordinarily valuable accomplishments of Dr. Chase and others in the arenas of science, education, and outreach without sufficient financial support. Because of recent reductions in financial support, these colleagues and friends of ours are at risk of losing the critical mass of scientists and technicians required for the department to maintain the magnificent record of accomplishments that has made members of this department – including Dr. Chase - leaders in the fields of dairy science and dairy science education.

A contributing factor to the loss of financial support may be that the department's constituency has diminished in numbers in recent years. However, although the number of dairy producers has decreased since Dr. Chase began his career at Cornell, the need for a strong and effective dairy science program at Cornell remains. In spite of a reduction in dairy farm numbers, a recent Cornell study reported that farm commodity receipts for the last 20 years have remained relatively constant after adjusting for price changes (Schmit and Bills, 2012). Dairy production is the predominant economic sector in New York agriculture, generating over 50% of total agricultural receipts. As of 2010, dairy production directly employs in excess of 20,155 people, and generates 2.25 billion dollars in output. Companies involved in feed production and distribution in New York employ in excess of 1500 people and generate nearly 1.9 billion dollars in output. In 2010, New York companies that process dairy products employed over 8,000 people and had an economic output of 5.4 billion dollars. These numbers have undoubtedly increased with the introduction of new milk processing facilities in recent years and due to currently higher milk demand and prices. Dr. Chase and his colleagues in Cornell's Department of Animal have contributed enormously to the ongoing viability and vitality of this very significant economic sector.

We are obligated to do far more than simply celebrate and pay tribute to Dr. Chase's career upon his retirement. In addition to our celebrations at this conference, we must honor Dr. Chase's accomplishments and commitment to dairy science and education by voicing our concerns about the department funding and resources to politicians at every level, and to university administrators as well. We need to make sure that they clearly understand that yes, Dr. Larry Chase made a difference, and that the difference wasn't simply a change in dairy cow productivity, but a strengthening of the dairy economy and its ability to continue to be a viable element in our economic and social well-being. We must educate them so that they understand that despite periodic economic uncertainties, it is critically important to continue to invest in the Department of Animal Science at Cornell, and in the Cooperative Extension system.

There is an additional important aspect of Dr. Chase's contributions that may not be apparent from the titles of his papers or descriptions of the agendas of the many meetings Dr. Chase organized and attended throughout his career. Dr. Chase is a scientist. A dairy scientist. A good scientist. And we desperately need scientists like Dr. Chase - especially for two reasons that are not necessarily immediately obvious.

First, dairy producers and their advisors are inundated these days by marketers of all kinds of products for the dairy industry. It is not within the capability of most of these individuals to effectively evaluate all the product offerings and technology decisions they must make, for a number of reasons. Chief among these reasons is that these individuals often do not have the training or experience required to evaluate the underlying science. This was a problem that Dr. Chase addressed effectively, and he did so sensitively. "Sensitively" here meaning he could render a critical opinion respectfully, and not confrontationally. For instance, consider some of the questions dairy producers and their advisors face – such as, "were there enough studies, or enough cows in these studies to really know the efficacy of a product beyond a

numerical outcome?" "Will it work in my herd?" Or "does the product marketed really make a difference as established by careful, well-controlled scientific studies? Dr. Chase could, and did, suggest an opinion to these individuals, about these and many other matters. And he can render those informed opinions, because as a scientist, Dr. Chase not only understands the underlying biology, but is also experienced in study designs and statistics, and how to apply those tools to evaluating whether an observed or suggested difference is likely to be real or not.

Second, increasingly we inhabit a world in which many people do not trust scientists and exhibit anti-science biases. In fact, much of the general public is increasingly skeptical of new technologies that play a role in the production of their food or are used their farm neighbors. This is shown in part by the public's rejection of milk from cows treated with rBST, and by the rejection by increasingly larger numbers of people of foods containing ingredients incorporating GMO technology. In spite of overwhelming consensus among the scientific community regarding the safety of these technologies, much of the general public does not understand the underlying science and is fearful of them. This anti-science bias becomes increasingly and frighteningly apparent with, for example, the rejection of childhood vaccination, or the GMO labeling law recently passed in Vermont. There is a desperate need for scientists who, like Dr. Chase, are capable of quietly and non-confrontationally shedding light on these and other topics that are potentially frightening to a uninformed populace.

CONCLUSION

In the space and time available here it has been difficult to describe in detail the magnitude of the impact Dr. Larry Chase has had on the dairy industry. Hopefully the overview of his work and activities presented in earlier sections of this paper have made it clear that Dr. Chase's impact has been enormous. Certainly, as a member of the industry and an avid consumer of the information contained in the extensive literature he has produced, I can vouch for the tremendous difference he has made in the careers of many of us at this conference and elsewhere in the dairy industry, in many ways. We will miss his tireless efforts, his gentle demeanor, his sage advice, his informative articles, and his guidance on the ever-expanding challenges faced by the dairy industry. Fortunately, Dr. Chase plans to continue some of his activities in his new capacity as an Emeritus faculty member, albeit with reduced intensity. Dr. Chase, we thank you for the outstanding job you have performed over the many years of your career in shepherding us to where we are today. And we look forward to continuing to benefit enormously from your intelligent and wise insights in the days to come.

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